

PATENT COOPERATION TREATY

PCT

NOTIFICATION OF ELECTION

(PCT Rule 61.2)

From the INTERNATIONAL BUREAU

To:

Assistant Commissioner for Patents
United States Patent and Trademark
Office
Box PCT
Washington, D.C. 20231
ETATS-UNIS D'AMERIQUE

in its capacity as elected Office

Date of mailing (day/month/year) 22 May 2000 (22.05.00)	Applicant's or agent's file reference 98P4851/F21518
International application No. PCT/GB99/03496	Priority date (day/month/year) 27 October 1998 (27.10.98)
International filing date (day/month/year) 27 October 1999 (27.10.99)	
Applicant HULBERT, Anthony, Peter	

1. The designated Office is hereby notified of its election made:

☒ in the demand filed with the International Preliminary Examining Authority on:
16 March 2000 (16.03.00)

☐ in a notice effecting later election filed with the International Bureau on:

2. The election ☒ was
☐ was not

made before the expiration of 19 months from the priority date or, where Rule 32 applies, within the time limit under Rule 32.2(b).

PCT

WORLD INTELLECTUAL PROPERTY ORGANIZATION
International Bureau



INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

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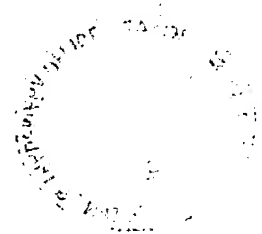
(71) Applicant (for all designated States except US): ROKE
MANOR RESEARCH LIMITED [GB/GB]; Roke Manor,
Old Salisbury Lane, Romsey, Hants SO51 0ZN (GB).

(72) Inventor; and
(75) Inventor/Applicant (for US only): HULBERT, Anthony, Peter
[GB/GB]; 48 Wilton Crescent, Shirley, Southampton, Hants
SO15 7QH (GB).

(74) Agent: KAY, Ross, Marcel; Siemens Shared Services Limited,
Intellectual Property Department, Siemens House, Oldbury,
Bracknell, Berkshire RG12 8FZ (GB).

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PT, SE).

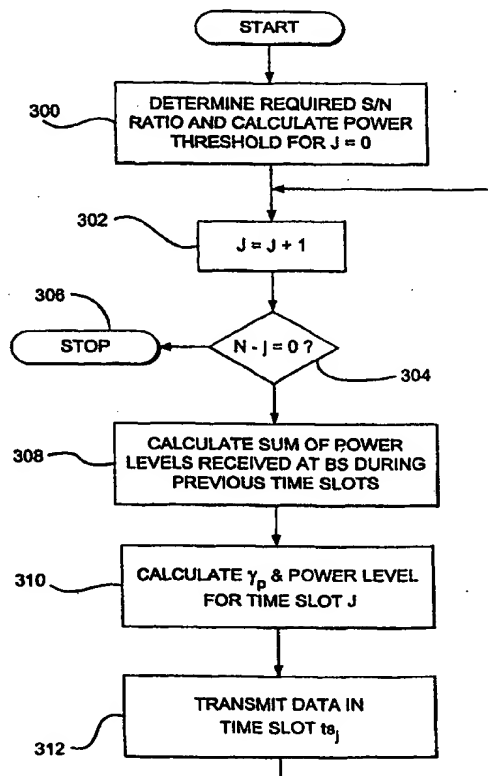
Published
With international search report.



(54) Title: METHOD OF AND APPARATUS FOR POWER CONTROL

(57) Abstract

When transmitting bursty data, for example packet data, a mobile terminal uses information relating to signal strength at the base station to determine the power at which the mobile terminal must transmit in order to produce a required signal to noise ratio at the base station. In frequency division duplex techniques, multi-path fading on the down-link is uncorrelated with multi-path fading on the up-link. Power measurements can be averaged at the mobile terminal over a likely fading period. However, this does not cater for instantaneous power level fluctuations in the up-link direction, which can result in the power transmitted by the mobile terminal being too high or too low at the start of a frame. The invention maintains a predetermined signal to noise ratio. At a given time slot, a power level is determined which, over remaining time slots, is based on the sum of power levels corresponding to previous time slots and the number of time slots remaining in the frame. Where multi-path fading occurs, smaller variations in average power over the frame will occur leading to improved system capacity.



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METHOD OF AND APPARATUS FOR POWER CONTROL

The present invention relates to a method of and apparatus for power control, of the type used in a communication system, for example, in a spread-spectrum communication system, such as a Code Division Multiple Access (CDMA) communication system.

In a CDMA cellular communication system, power control is used to equalize signal to noise (S/N) ratios of the signals received at a base station from various mobile terminals. In the term 'signal to noise ratio', the term 'noise' is intended to include interference in the form of signals from other mobile terminals, as well as background noise.

A known technique involves measuring the S/N ratio in respect of signals received from a given mobile terminal over a measurement interval and comparing the measured S/N ratio against a desired threshold. If the measured S/N ratio exceeds the desired threshold, a binary 1 (or 0, depending upon the convention employed) is transmitted (within the plurality of signals transmitted from the base station) to the mobile terminal originating the given signal. If the measured S/N ratio is lower than the desired threshold, a binary 0 (or 1, depending upon the convention employed) is transmitted to the given mobile terminal. The mobile terminal, in turn, responds by reducing its transmission power by, for example, 1 dB if a 1 (or 0) is received or by increasing its power by 1 dB if a 0 (or 1) is received. In this way, the received S/N ratio is held approximately constant as path loss between the given mobile station and the base station varies and/or as the level of interference at the base station from other mobile terminals varies.

The above technique is effective in the transmission of continuous data where any transients associated with the initial setting of transmitter power at

the mobile terminal can be ignored. However, where individual bursts (frames) of data are transmitted, for example packet data, the mobile terminal must set its initial transmitter power according to a so-called open loop power control technique. In this technique, the base station signals to the mobile terminal(s) the power at which the base station is transmitting; this can be either the total power received or the power of a particular signal which the mobile(s) station is receiving, and the interference level at the base station. The mobile terminal measures the power level of the corresponding signal received from the base station and uses the signalled information, i.e. the information relating to signal strength at the base station, to determine the power at which the mobile terminal must transmit in order to produce a required S/N ratio at the base station. On average, this should be the correct power. However, in many CDMA systems the frequency used for transmission from the base station to the mobile terminal (down-link) is different from the frequency used for transmission from the mobile terminal to the base station (up-link). Such a scheme is known as a Frequency Division Duplex (FDD) technique. In an FDD technique, propagation of signals is non-reciprocal in the short term, for example, multi-path fading on the down-link is uncorrelated with multi-path fading on the up-link. This effect can be mitigated somewhat by averaging the power measurements at the mobile terminal over the likely fading period. However, this does not cater for the instantaneous path level fluctuations in the up-link direction, resulting in the power transmitted by the mobile terminal being too high or too low at the start of the frame.

In a typical CDMA system, Forward Error Correction (FEC) with interleaving is employed in order to mitigate the effects of fading and interference from other signals operating on the same frequency. If a known soft decision decoding technique is employed, the effect of the interleaving is to

make the probability of uncorrectable errors in an interleaved frame a function more of the average S/N ratio over the frame rather than, for example, the worst case S/N ratio. Consequently, if the S/N ratio at the start of a frame is too high, implementation of power control reduces the S/N ratio to the required threshold by the end of the frame, but the overall average will be higher than necessary. Conversely, if the S/N ratio at the start of a frame is too low, implementation of power control increases the S/N ratio to the required threshold by the end of the frame, but the overall average will be lower than necessary.

It is therefore an object of the present invention to obviate or at least mitigate the above described disadvantages.

According to the present invention, there is provided a method of power control in a communications system capable of transmitting a frame having a plurality of time intervals, the method comprising the steps of: selecting a time interval in respect of which a power level is to be determined; summing any previously measured power levels in respect of any time intervals preceding the selected time interval; determining the number of any remaining time intervals, and setting the power level in respect of the selected time interval based upon the sum of previously measured power levels and the number of remaining intervals in order to achieve a predetermined S/N ratio in respect of the frame.

Preferably, the power level is set during transmission of the frame in such a way as to tend to keep the received signal to noise averaged over the frame constant.

Thus, if the signal is received at a S/N ratio higher than necessary at the beginning of a frame, the method will ensure that the signal will be received at a level lower than the nominal S/N ratio by the end of the frame. Where multi-path fading occurs the use of this method will result in smaller variation in average power over the frame, leading to an improvement in system capacity.

This differs from known techniques which try to modify the power level within each time interval so as to substantially keep to the predetermined signal to noise ratio during each interval.

Preferably, the time interval is a time slot.

At least one embodiment of the invention will now be described by way of example, with reference to the accompanying drawings, in which:

FIGURE 1 is a schematic diagram of the entities used in a communications system,

FIGURE 2 is a schematic diagram of a frame used by the system of Figure 1, and

FIGURE 3 is a flowchart of a method constituting an embodiment of the present invention.

Referring to Figure 1, a CDMA system comprises at least one base station 102 supporting a cell 104, the base station 102 being arranged to communicate with a mobile terminal 106 over a radio-frequency (RF) interface 108 by transmitting a frame 200 of data (Figure 2). The frame 200 comprises N time slots ts_0, \dots, ts_{N-1} .

In operation, the frame 200 is transmitted from the mobile terminal 106 to the base station 102, during which power control is achieved by N adjustments of power corresponding to N time slots in the frame 200.

Referring to Figure 3, a required average S/N ratio γ_d at the base station 102 over the duration of the frame 200 is initially determined and set (step 300). A power level is then set so that the average S/N ratio γ_d per time slot at the base station 102 will be substantially met (step 300).

A subsequent time slot, ts_j , for which the power level is to be adjusted, is then selected (step 302) and the number of any remaining time slots, $N-j$, is determined (step 304). If the number of time slots remaining, $N-j$, is zero, no

further power levels are set for the frame 200 (step 306). If, however, one or more time slots remain, the sum of respective measured power levels received at the base station 102 during previous time slots is calculated (step 308). The calculation can be generally expressed as: $\sum_{i=0}^{j-1} \gamma_i$, where γ_i is the S/N ratio received in the i th slot.

Using the sum of the measured power levels, the predetermined average S/N ratio γ_d and knowledge of the number of remaining time slots, a predicted S/N ratio, γ_p is then calculated (step 310) and the value of γ_p is used to calculate the power level at which the mobile terminal 106 transmits signals to the base station 102. The equation used to calculate the predicted S/N ratio γ_p is derived as follows.

The predicted S/N ratio γ_p is calculated based upon the assumption that a target, of the average S/N ratio, γ_d , across the frame 200, will be met if the calculated predicted S/N ratio γ_p is maintained throughout the remainder of the frame 200, thereby keeping the average S/N ratio γ_d substantially constant over the frame 200.

Since $N-j$ power control intervals (time slots) remain in the frame 200 for which a power level is to be predicted, in order to satisfy the S/N ratio requirement of $N\gamma_d$ for the entire frame 200, the predicted S/N ratio γ_p for the remaining intervals, γ_p needs to satisfy the following equation:

$$\sum_{i=0}^{j-1} \gamma_i + (N-j)\gamma_p = N\gamma_d$$

Thus, the above equation is solved for γ_p and hence the predicted required power level (and therefore the next threshold) is calculated using the following equation:

$$\gamma_p = \frac{N\gamma_d - \sum_{i=0}^{j-1} \gamma_i}{N-j}$$

During the selected time slot, ts_j , the mobile terminal 106 transmits at the power level set (step 312) corresponding to the associated predicted S/N ratio γ_p .

A subsequent time slot is then selected (step 302) and the above-described procedure for calculating and setting power levels is repeated (steps 304 to 312).

Minor obvious modifications can be made within the normal ability of a skilled person to take account of non zero periods for measurement and for signalling within the power control sub-system.

Claims:

1. A method of power control in a communications system capable of transmitting a frame having a plurality of time intervals, the method comprising the steps of:
 - selecting a time interval in respect of which a power level is to be determined;
 - summing any previously measured power levels in respect of any time intervals preceding the selected time interval;
 - determining the number of any remaining time intervals; and
 - setting the power level in respect of the selected time interval based upon the sum of previously measured power levels and the number of remaining intervals so as to achieve a predetermined signal to noise ratio in respect of the frame.
2. A method according to Claim 1, wherein the power level setting step takes place during transmission of the frame.
3. A method according to Claim 1, wherein the power level setting step keeps the received signal to noise ratio averaged over the frame substantially constant.
4. A method according to Claim 1, wherein the time interval is a time slot.
5. A method according to Claim 1, wherein the communications system is a spread spectrum communications system.

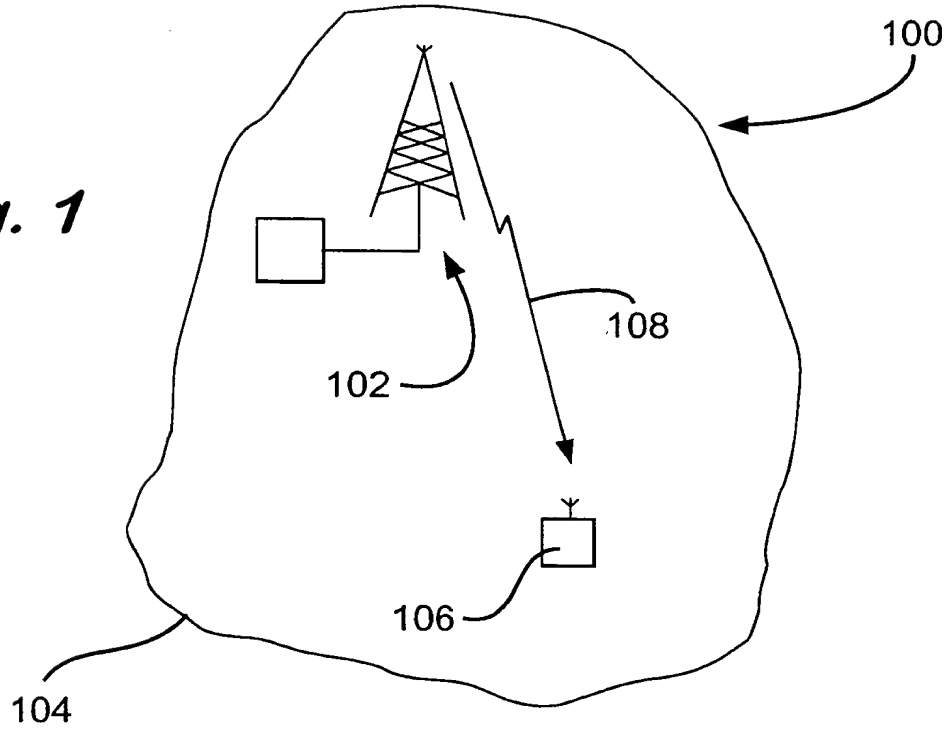
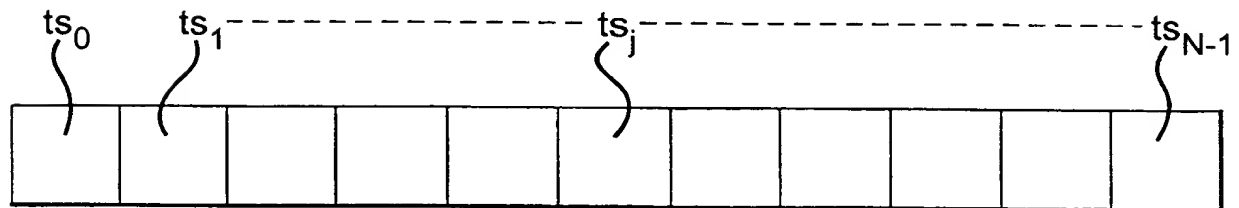
6. A method according to Claim 5, wherein the spread spectrum communications system is a CDMA communications system.

7. A method according to Claim 6, wherein the power level setting step achieves a signal to noise ratio, γ_p , which is given by the formula:

$$\gamma_p = \frac{N\gamma_d - \sum_{i=0}^{j-1} \gamma_i}{N - j}$$

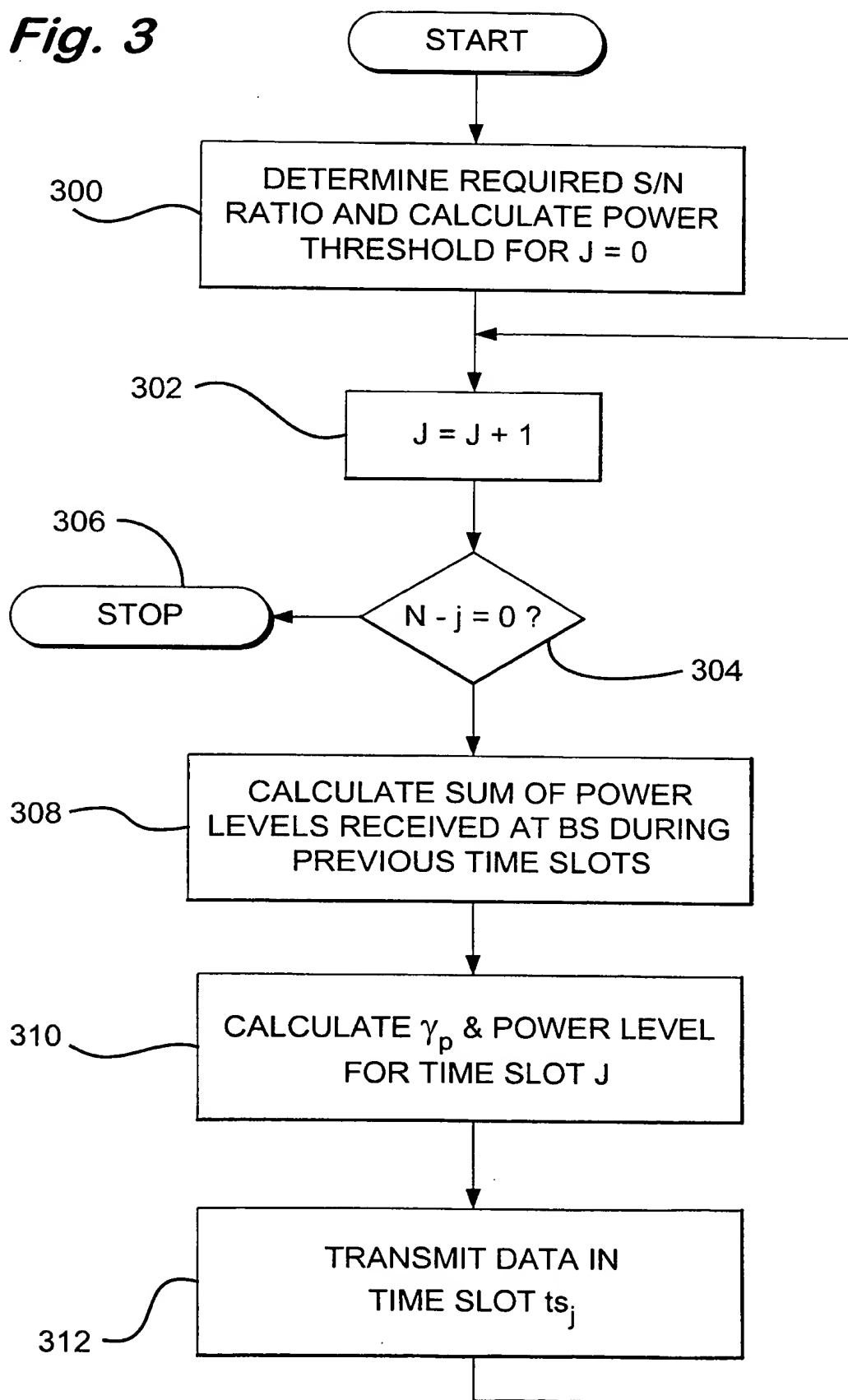
wherein γ_i is the S/N ratio received at the base station in the i th interval; $\sum_{i=0}^{j-1} \gamma_i$ is the sum of S/N ratios received corresponding to previous time intervals; and $N\gamma_d$ is the desired total S/N ratio sum over the frame.

8. A method substantially as hereinbefore described with reference to Figure 3.

Fig. 1**Fig. 2**

200

2/2

Fig. 3

INTERNATIONAL SEARCH REPORT

Inter Application No

PCT/GB 99/03496

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 H04B7/005

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 H04B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 5 305 468 A (BRUCKERT EUGENE J ET AL) 19 April 1994 (1994-04-19) abstract column 3, line 29 -column 5, line 56 claims 1-3 figures 5-7	1,8
A	WO 97 17769 A (MARTIN PAUL MAXWELL ;IONICA INT LTD (GB); GOODINGS RUPERT LESLIE A) 15 May 1997 (1997-05-15) page 1, line 13 -page 4, line 19 claims 1,2 --- -/--	1,8

☒ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search

17 December 1999

Date of mailing of the international search report

12/01/2000

Name and mailing address of the ISA

European Patent Office, P.B. 5818 Patentlaan 2
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Tel. (+31-70) 340-2040, Tx. 31 651 epo nl,
Fax: (+31-70) 340-3016

Authorized officer

Gkeli, M

INTERNATIONAL SEARCH REPORT

Inte: Application No

PCT/GB 99/03496

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	EP 0 810 743 A (NIPPON ELECTRIC CO) 3 December 1997 (1997-12-03) column 1, line 42 -column 2, line 29 column 4, line 14 - line 59 column 6, line 46 -column 8, line 6 claim 1 figures 1-3 -----	1,8

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

PCT/GB 99/03496

Patent document cited in search report		Publication date	Patent family member(s)	Publication date
US 5305468	A	19-04-1994	CA 2088720 A,C KR 9608955 B	19-09-1993 10-07-1996
WO 9717769	A	15-05-1997	AU 7501696 A BR 9611481 A EP 0860058 A	29-05-1997 02-02-1999 26-08-1998
EP 0810743	A	03-12-1997	JP 2785804 B JP 9321699 A AU 2368697 A CA 2206365 A CN 1167411 A	13-08-1998 12-12-1997 04-12-1997 30-11-1997 10-12-1997

**INTERNATIONAL PRELIMINARY
EXAMINATION REPORT**

International application No. PCT/GB99/03496

- ☐ the description, pages:
- ☐ the claims, Nos.:
- ☐ the drawings, sheets:

5. ☒ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)):

(Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report.)

see separate sheet

6. Additional observations, if necessary:
see separate sheet

III. Non-establishment of opinion with regard to novelty, inventive step and industrial applicability

1. The questions whether the claimed invention appears to be novel, to involve an inventive step (to be non-obvious), or to be industrially applicable have not been examined in respect of:

- ☐ the entire international application.
- ☒ claims Nos. 8.

because:

- ☐ the said international application, or the said claims Nos. relate to the following subject matter which does not require an international preliminary examination (*specify*):
- ☒ the description, claims or drawings (*indicate particular elements below*) or said claims Nos. 8 are so unclear that no meaningful opinion could be formed (*specify*):
see separate sheet
- ☐ the claims, or said claims Nos. are so inadequately supported by the description that no meaningful opinion could be formed.
- ☐ no international search report has been established for the said claims Nos. .

2. A meaningful international preliminary examination report cannot be carried out due to the failure of the nucleotide and/or amino acid sequence listing to comply with the standard provided for in Annex C of the Administrative Instructions:

- ☐ the written form has not been furnished or does not comply with the standard.
- ☐ the computer readable form has not been furnished or does not comply with the standard.

V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

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From the INTERNATIONAL BUREAU

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NOTICE INFORMING THE APPLICANT OF THE
COMMUNICATION OF THE INTERNATIONAL
APPLICATION TO THE DESIGNATED OFFICES

(PCT Rule 47.1(c), first sentence)

To:

KAY, Ross, Marcel
Siemens Shared Services Limited
Intellectual Property Department
Siemens House
Oldbury, Bracknell
Berkshire RG12 8FZ
ROYAUME-UNI
RECEIVED
17 MAY 2000

Date of mailing (day/month/year)

04 May 2000 (04.05.00)

Applicant's or agent's file reference

98P4851/F21518

IMPORTANT NOTICE

International application No.

PCT/GB99/03496

International filing date (day/month/year)

27 October 1999 (27.10.99)

Priority date (day/month/year)

27 October 1998 (27.10.98)

Applicant

ROKE MANOR RESEARCH LIMITED et al

1. Notice is hereby given that the International Bureau has communicated, as provided in Article 20, the international application to the following designated Offices on the date indicated above as the date of mailing of this Notice:

CN,JP,US

In accordance with Rule 47.1(c), third sentence, those Offices will accept the present Notice as conclusive evidence that the communication of the international application has duly taken place on the date of mailing indicated above and no copy of the international application is required to be furnished by the applicant to the designated Office(s).

2. The following designated Offices have waived the requirement for such a communication at this time:

EP

The communication will be made to those Offices only upon their request. Furthermore, those Offices do not require the applicant to furnish a copy of the international application (Rule 49.1(a-bis)).

3. Enclosed with this Notice is a copy of the international application as published by the International Bureau on 04 May 2000 (04.05.00) under No. WO 00/25444

REMINDER REGARDING CHAPTER II (Article 31(2)(a) and Rule 54.2)

If the applicant wishes to postpone entry into the national phase until 30 months (or later in some Offices) from the priority date, a demand for international preliminary examination must be filed with the competent International Preliminary Examining Authority before the expiration of 19 months from the priority date.

It is the applicant's sole responsibility to monitor the 19-month time limit.

Note that only an applicant who is a national or resident of a PCT Contracting State which is bound by Chapter II has the right to file a demand for international preliminary examination.

REMINDER REGARDING ENTRY INTO THE NATIONAL PHASE (Article 22 or 39(1))

If the applicant wishes to proceed with the international application in the national phase, he must, within 20 months or 30 months, or later in some Offices, perform the acts referred to therein before each designated or elected Office.

For further important information on the time limits and acts to be performed for entering the national phase, see the Annex to Form PCT/IB/301 (Notification of Receipt of Record Copy) and Volume II of the PCT Applicant's Guide.

The International Bureau of WIPO
34, chemin des Colombettes
1211 Geneva 20, Switzerland

Facsimile No. (41-22) 740.14.35

Authorized officer

J. Zahra

Telephone No. (41-22) 338.83.38

PATENT COOPERATION TREATY

From the
INTERNATIONAL PRELIMINARY EXAMINING AUTHORITY

PCT

To:

Kay, Ross Marcel.
SIEMENS SHARED SERVICE LIMITED
Intellectual Property Department
Siemens House
Oldbury
Bracknell
Berkshire RG12 8FZ
GRANDE BRETAGNE

RECEIVED
- 2 JAN 2001

NOTIFICATION OF TRANSMITTAL OF
THE INTERNATIONAL PRELIMINARY
EXAMINATION REPORT
(PCT Rule 71.1)

Date of mailing (day/month/year)	22.12.2000
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Applicant's or agent's file reference F21518/98P4851	IMPORTANT NOTIFICATION
---------------------------------------------------------	-------------------------------

International application No. PCT/GB99/03496	International filing date (day/month/year) 27/10/1999	Priority date (day/month/year) 27/10/1998
-------------------------------------------------	----------------------------------------------------------	----------------------------------------------

Applicant
ROKE MANOR RESEARCH LIMITED et al.

1. The applicant is hereby notified that this International Preliminary Examining Authority transmits herewith the international preliminary examination report and its annexes, if any, established on the international application.
2. A copy of the report and its annexes, if any, is being transmitted to the International Bureau for communication to all the elected Offices.
3. Where required by any of the elected Offices, the International Bureau will prepare an English translation of the report (but not of any annexes) and will transmit such translation to those Offices.

4. REMINDER

The applicant must enter the national phase before each elected Office by performing certain acts (filing translations and paying national fees) within 30 months from the priority date (or later in some Offices) (Article 39(1)) (see also the reminder sent by the International Bureau with Form PCT/IB/301).

Where a translation of the international application must be furnished to an elected Office, that translation must contain a translation of any annexes to the international preliminary examination report. It is the applicant's responsibility to prepare and furnish such translation directly to each elected Office concerned.

For further details on the applicable time limits and requirements of the elected Offices, see Volume II of the PCT Applicant's Guide.

Name and mailing address of the IPEA/	Authorized officer
---------------------------------------	--------------------



European Patent Office
D-80298 Munich
Tel. +49 89 2399 - 0 Tx: 523656 epmu d
Fax: +49 89 2399 - 4465

Pelatti, V

Tel. +49 89 2399-7309



PCT

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference F21518/98P4851	FOR FURTHER ACTION See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416)	
International application No. PCT/GB99/03496	International filing date (day/month/year) 27/10/1999	Priority date (day/month/year) 27/10/1998
International Patent Classification (IPC) or national classification and IPC H04B7/005		
Applicant ROKE MANOR RESEARCH LIMITED et al.		

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.



2. This REPORT consists of a total of 7 sheets, including this cover sheet.

- ☒ This report is also accompanied by ANNEXES, i.e. sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

These annexes consist of a total of 5 sheets.

3. This report contains indications relating to the following items:

- I ☒ Basis of the report
- II ☐ Priority
- III ☒ Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- IV ☐ Lack of unity of invention
- V ☒ Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
- VI ☐ Certain documents cited
- VII ☐ Certain defects in the international application
- VIII ☒ Certain observations on the international application

Date of submission of the demand 16/03/2000	Date of completion of this report 22.12.2000
Name and mailing address of the international preliminary examining authority:  European Patent Office D-80298 Munich Tel. +49 89 2399 - 0 Tx: 523656 epmu d Fax: +49 89 2399 - 4465	Authorized officer Draper, A Telephone No. +49 89 2399 8947 

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No. PCT/GB99/03496

I. Basis of the report

1. This report has been drawn on the basis of *(substitute sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to the report since they do not contain amendments (Rules 70.16 and 70.17).)*:

Description, pages:

1,2,4-6	as originally filed	
3,3a	with telefax of	16/10/2000

Claims, No.:

1-11	with telefax of	16/10/2000
------	-----------------	------------

Drawings, sheets:

1/2,2/2	as originally filed
---------	---------------------

2. With regard to the **language**, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.

These elements were available or furnished to this Authority in the following language: , which is:

- ☐ the language of a translation furnished for the purposes of the international search (under Rule 23.1(b)).
- ☐ the language of publication of the international application (under Rule 48.3(b)).
- ☐ the language of a translation furnished for the purposes of international preliminary examination (under Rule 55.2 and/or 55.3).

3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:

- ☐ contained in the international application in written form.
- ☐ filed together with the international application in computer readable form.
- ☐ furnished subsequently to this Authority in written form.
- ☐ furnished subsequently to this Authority in computer readable form.
- ☐ The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.
- ☐ The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.

4. The amendments have resulted in the cancellation of:

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No. PCT/GB99/03496

1. Statement

Novelty (N)	Yes:	Claims	1-7
	No:	Claims	
Inventive step (IS)	Yes:	Claims	1-7
	No:	Claims	
Industrial applicability (IA)	Yes:	Claims	1-7
	No:	Claims	

2. Citations and explanations see separate sheet

VIII. Certain observations on the international application

The following observations on the clarity of the claims, description, and drawings or on the question whether the claims are fully supported by the description, are made:
see separate sheet

Section I

- 1). Claim 1 has been greatly and unallowably broadened against original claim 1.

Original claim 1 recited, in summary, the following steps;

- select a time interval,
- sum measured power levels for preceding intervals [in the frame],
- determine number of remaining intervals [in the frame],
- set power in selected interval based on preceding power levels and number of intervals remaining [in the frame] to achieve a predetermined [average] S/N ratio over the frame.

Apart from the clarification that information is passed from the transmitter to the receiver, new claim 1 is reduced to reciting that the receiver seeks to maintain an average S/N ratio across the frame. This wording encompasses a range of possibilities which was not directly and unambiguously foreseen by the original disclosure, and thus claim 1 infringes Article 34.2.(b) PCT.

It is noted that the penultimate paragraph on page 3 is not found to support new claim 1, since it has to be read in the context of the paragraph which precedes it.

- 2). Claims 2 and 11 also infringe Article 34.2.(b) PCT.

In step i. it is recited merely that the initial transmission level is set. The only support for this step in the original disclosure appears to be in the second last paragraph of page 4 and in the flowchart of Fig. 3, box 300. Here it is stated that "a required average S/N ratio...at the base station...over the duration of the frame...is initially determined and set". Thus there is no support for a setting of the initial level to any arbitrary value as presently encompassed by claims 2 and 11.

In step ii. it is recited that the "cumulative SNR value over the received time interval of the frame" is determined. This is different from "summing any previously measured power levels [for each time interval]" (cf. original claim 1).

**INTERNATIONAL PRELIMINARY
EXAMINATION REPORT - SEPARATE SHEET**

International application No. PCT/GB99/03496

Summing the levels means adding together discrete values. Determining a cumulative value can encompass many more mathematical operations, including, for example, continuous integration which were not directly and unambiguously disclosed originally.

- 3). Claim 3 is also not fully supported by the original disclosure.
The original disclosure stated that the predetermined average signal to noise ratio was that average S/N ratio at the base station over the duration of the frame (see description page 4, last full paragraph).
- 4). No original support at all can be found for new claim 9.
- 5). In view of the fact that it would lead to a meaningless outcome if the present claims were to be examined for novelty and inventive step in respect only of the features which are originally supported, this report is being established on the basis of the originally-filed claims.
- 6). For similar reasons the adaptations to the description infringe Article 34(2)(b) and are thus also ignored.

Section III

- 1). Claim 8: The scope of this claim is indeterminable. See PCT Guidelines III-4.10 and Rule 6.2(a) PCT.

Section V

- 1). The invention relies on the insight that interleaving means that the probability of uncorrectable errors in an interleaved frame is a function more of the average S/N ratio over the frame than the worst case S/N ratio.
- 2). Essentially the invention resides in a method of power control wherein the received power level in each preceding time interval (slot) is measured, and the power level is set in the current slot taking into account the sum of the so-measured power levels and the number of remaining intervals (slots) in the

current frame so as to achieve a predetermined average s/N ratio over the frame.

- 3). None of the available prior art discloses or hints at such a technique.

Section VIII

Claim 1 is considered, in principle, to relate to novel and inventive subject-matter. However, the claims are unclear (Article 6 PCT) in the following respects:

- 1). Claim 1:

a) It is not clear that the "time intervals preceding the selected time interval" are time intervals in the current frame.

b) Similarly, it is not clear that the "number of any remaining time intervals" is the number remaining in the current frame.

c) Similarly, it is not clear that the "sum of previously measured power levels" is the sum of measured power levels previously measured in the current frame.

d) The expression "so as to achieve a predetermined signal to noise ratio in respect of the frame" is obscure. It should have been clarified that the predetermined signal to noise ratio is achieved averaged over the frame.

- 2). Claim 2:

This claim casts doubt on the intended scope of claim 1. How can the power level be set other than during the transmission of the frame if, as stated in the last paragraph of claim 1, the power level for the "selected" time interval is set based inter alia on previously measured power levels [in the current frame]. It seems this claim should have been deleted.

- 3). Claim 3:

It is unclear whether this is intended to specify that the average S/N is substantially constant from frame to frame or, in some manner, is constant during a single frame.

- 4). Claim 8:

The scope of this claim is indeterminable. See PCT Guidelines III-4.10 and Rule 6.2(a) PCT. It should have been deleted.

make the probability of uncorrectable errors in an interleaved frame a function more of the average S/N ratio over the frame rather than, for example, the worst case S/N ratio. Consequently, if the S/N ratio at the start of a frame is too high, implementation of power control reduces the S/N ratio to the required threshold by the end of the frame, but the overall average will be higher than necessary. Conversely, if the S/N ratio at the start of a frame is too low, implementation of power control increases the S/N ratio to the required threshold by the end of the frame, but the overall average will be lower than necessary.

It is therefore an object of the present invention to obviate or at least mitigate the above described disadvantages.

According to the present invention, there is provided a method of power control in a communications system capable of transmitting a frame having a plurality of time intervals, the method comprising the steps of: selecting a time interval in respect of which a power level is to be determined; summing any previously measured power levels in respect of any time intervals preceding the selected time interval; determining the number of any remaining time intervals, and setting the power level in respect of the selected time interval based upon the sum of previously measured power levels and the number of remaining intervals in order to achieve a predetermined S/N ratio in respect of the frame.

Preferably, the power level is set during transmission of the frame in such a way as to tend to keep the received signal to noise averaged over the frame constant.

Thus, if the signal is received at a S/N ratio higher than necessary at the beginning of a frame, the method will ensure that the signal will be received at a level lower than the nominal S/N ratio by the end of the frame. Where multi-path fading occurs the use of this method will result in smaller variation in average power over the frame, leading to an improvement in system capacity.

Claims:

1. A method of power control in a communications system capable of transmitting a frame having a plurality of time intervals, the method comprising the steps of:
 - selecting a time interval in respect of which a power level is to be determined;
 - summing any previously measured power levels in respect of any time intervals preceding the selected time interval;
 - determining the number of any remaining time intervals; and
 - setting the power level in respect of the selected time interval based upon the sum of previously measured power levels and the number of remaining intervals so as to achieve a predetermined signal to noise ratio in respect of the frame.
2. A method according to Claim 1, wherein the power level setting step takes place during transmission of the frame.
3. A method according to Claim 1, wherein the power level setting step keeps the received signal to noise ratio averaged over the frame substantially constant.
4. A method according to Claim 1, wherein the time interval is a time slot.
5. A method according to Claim 1, wherein the communications system is a spread spectrum communications system.

6. A method according to Claim 5, wherein the spread spectrum communications system is a CDMA communications system.

7. A method according to Claim 6, wherein the power level setting step achieves a signal to noise ratio, γ_p , which is given by the formula:

$$\gamma_p = \frac{N\gamma_d - \sum_{i=0}^{j-1} \gamma_i}{N - j}$$

wherein γ_i is the S/N ratio received at the base station in the i th interval; $\sum_{i=0}^{j-1} \gamma_i$ is the sum of S/N ratios received corresponding to previous time intervals; and $N\gamma_d$ is the desired total S/N ratio sum over the frame.

8. A method substantially as hereinbefore described with reference to Figure 3.

REC'D 29 DEC 2000

WIPO PCT

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference F21518/98P4851	FOR FURTHER ACTION See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416)	
International application No. PCT/GB99/03496	International filing date (day/month/year) 27/10/1999	Priority date (day/month/year) 27/10/1998
International Patent Classification (IPC) or national classification and IPC H04B7/005		
Applicant ROKE MANOR RESEARCH LIMITED et al.		

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.



2. This REPORT consists of a total of 7 sheets, including this cover sheet.

- ☒ This report is also accompanied by ANNEXES, i.e. sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

These annexes consist of a total of 5 sheets.

3. This report contains indications relating to the following items:

- I ☒ Basis of the report
- II ☐ Priority
- III ☒ Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- IV ☐ Lack of unity of invention
- V ☒ Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
- VI ☐ Certain documents cited
- VII ☐ Certain defects in the international application
- VIII ☒ Certain observations on the international application

Date of submission of the demand 16/03/2000	Date of completion of this report 22.12.2000
Name and mailing address of the international preliminary examining authority:  European Patent Office D-80298 Munich Tel. +49 89 2399 - 0 Tx: 523656 epmu d Fax: +49 89 2399 - 4465	Authorized officer Draper, A Telephone No. +49 89 2399 8947 

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No. PCT/GB99/03496

I. Basis of the report

1. This report has been drawn on the basis of *(substitute sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to the report since they do not contain amendments (Rules 70.16 and 70.17).):*

Description, pages:

1,2,4-6	as originally filed	
3,3a	with telefax of	16/10/2000

Claims, No.:

1-11	with telefax of	16/10/2000
------	-----------------	------------

Drawings, sheets:

1/2,2/2	as originally filed
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2. With regard to the **language**, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.

These elements were available or furnished to this Authority in the following language: , which is:

- ☐ the language of a translation furnished for the purposes of the international search (under Rule 23.1(b)).
- ☐ the language of publication of the international application (under Rule 48.3(b)).
- ☐ the language of a translation furnished for the purposes of international preliminary examination (under Rule 55.2 and/or 55.3).

3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:

- ☐ contained in the international application in written form.
- ☐ filed together with the international application in computer readable form.
- ☐ furnished subsequently to this Authority in written form.
- ☐ furnished subsequently to this Authority in computer readable form.
- ☐ The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.
- ☐ The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.

4. The amendments have resulted in the cancellation of:

**INTERNATIONAL PRELIMINARY
EXAMINATION REPORT**

International application No. PCT/GB99/03496

- ☐ the description, pages:
☐ the claims, Nos.:
☐ the drawings, sheets:

5. ☒ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)):

(Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report.)

see separate sheet

6. Additional observations, if necessary:
see separate sheet

III. Non-establishment of opinion with regard to novelty, inventive step and industrial applicability

1. The questions whether the claimed invention appears to be novel, to involve an inventive step (to be non-obvious), or to be industrially applicable have not been examined in respect of:

- ☐ the entire international application.
☒ claims Nos. 8.

because:

- ☐ the said international application, or the said claims Nos. relate to the following subject matter which does not require an international preliminary examination (*specify*):
- ☒ the description, claims or drawings (*indicate particular elements below*) or said claims Nos. 8 are so unclear that no meaningful opinion could be formed (*specify*):
see separate sheet
- ☐ the claims, or said claims Nos. are so inadequately supported by the description that no meaningful opinion could be formed.
- ☐ no international search report has been established for the said claims Nos. .

2. A meaningful international preliminary examination report cannot be carried out due to the failure of the nucleotide and/or amino acid sequence listing to comply with the standard provided for in Annex C of the Administrative Instructions:

- ☐ the written form has not been furnished or does not comply with the standard.
☐ the computer readable form has not been furnished or does not comply with the standard.

V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No. PCT/GB99/03496

1. Statement

Novelty (N)	Yes: Claims 1-7
	No: Claims
Inventive step (IS)	Yes: Claims 1-7
	No: Claims
Industrial applicability (IA)	Yes: Claims 1-7
	No: Claims

2. Citations and explanations see separate sheet

VIII. Certain observations on the international application

The following observations on the clarity of the claims, description, and drawings or on the question whether the claims are fully supported by the description, are made:
see separate sheet

Section I

- 1). Claim 1 has been greatly and unallowably broadened against original claim 1.

Original claim 1 recited, in summary, the following steps;

- select a time interval,
- sum measured power levels for preceding intervals [in the frame],
- determine number of remaining intervals [in the frame],
- set power in selected interval based on preceding power levels and number of intervals remaining [in the frame] to achieve a predetermined [average] S/N ratio over the frame.

Apart from the clarification that information is passed from the transmitter to the receiver, new claim 1 is reduced to reciting that the receiver seeks to maintain an average S/N ratio across the frame. This wording encompasses a range of possibilities which was not directly and unambiguously foreseen by the original disclosure, and thus claim 1 infringes Article 34.2.(b) PCT.

It is noted that the penultimate paragraph on page 3 is not found to support new claim 1, since it has to be read in the context of the paragraph which precedes it.

- 2). Claims 2 and 11 also infringe Article 34.2.(b) PCT.

In step i. it is recited merely that the initial transmission level is set. The only support for this step in the original disclosure appears to be in the second last paragraph of page 4 and in the flowchart of Fig. 3, box 300. Here it is stated that "a required average S/N ratio...at the base station...over the duration of the frame...is initially determined and set". Thus there is no support for a setting of the initial level to any arbitrary value as presently encompassed by claims 2 and 11.

In step ii. it is recited that the "cumulative SNR value over the received time interval of the frame" is determined. This is different from "summing any previously measured power levels [for each time interval]" (cf. original claim 1).

**INTERNATIONAL PRELIMINARY
EXAMINATION REPORT - SEPARATE SHEET**

International application No. PCT/GB99/03496

Summing the levels means adding together discrete values. Determining a cumulative value can encompass many more mathematical operations, including, for example, continuous integration which were not directly and unambiguously disclosed originally.

- 3). Claim 3 is also not fully supported by the original disclosure.
The original disclosure stated that the predetermined average signal to noise ratio was that average S/N ratio at the base station over the duration of the frame (see description page 4, last full paragraph).
- 4). No original support at all can be found for new claim 9.
- 5). In view of the fact that it would lead to a meaningless outcome if the present claims were to be examined for novelty and inventive step in respect only of the features which are originally supported, this report is being established on the basis of the originally-filed claims.
- 6). For similar reasons the adaptations to the description infringe Article 34(2)(b) and are thus also ignored.

Section III

- 1). Claim 8: The scope of this claim is indeterminable. See PCT Guidelines III-4.10 and Rule 6.2(a) PCT.

Section V

- 1). The invention relies on the insight that interleaving means that the probability of uncorrectable errors in an interleaved frame is a function more of the average S/N ratio over the frame than the worst case S/N ratio.
- 2). Essentially the invention resides in a method of power control wherein the received power level in each preceding time interval (slot) is measured, and the power level is set in the current slot taking into account the sum of the so-measured power levels and the number of remaining intervals (slots) in the

current frame so as to achieve a predetermined average s/N ratio over the frame.

- 3). None of the available prior art discloses or hints at such a technique.

Section VIII

Claim 1 is considered, in principle, to relate to novel and inventive subject-matter. However, the claims are unclear (Article 6 PCT) in the following respects:

- 1). Claim 1:
 - a) It is not clear that the "time intervals preceding the selected time interval" are time intervals in the current frame.
 - b) Similarly, it is not clear that the "number of any remaining time intervals" is the number remaining in the current frame.
 - c) Similarly, it is not clear that the "sum of previously measured power levels" is the sum of measured power levels previously measured in the current frame.
 - d) The expression "so as to achieve a predetermined signal to noise ratio in respect of the frame" is obscure. It should have been clarified that the predetermined signal to noise ratio is achieved averaged over the frame.
- 2). Claim 2:

This claim casts doubt on the intended scope of claim 1. How can the power level be set other than during the transmission of the frame if, as stated in the last paragraph of claim 1, the power level for the "selected" time interval is set based inter alia on previously measured power levels [in the current frame]. It seems this claim should have been deleted.
- 3). Claim 3:

It is unclear whether this is intended to specify that the average S/N is substantially constant from frame to frame or, in some manner, is constant during a single frame.
- 4). Claim 8:

The scope of this claim is indeterminable. See PCT Guidelines III-4.10 and Rule 6.2(a) PCT. It should have been deleted.

Claims:

1. A method of power control in a communications system capable of transmitting a frame having a plurality of time intervals from a transmitter to a receiver, wherein power control is effected on the individual time intervals based upon information passed from the receiver to the transmitter, wherein the receiver seeks to maintain an average signal to noise ratio across the frame.
2. A method according to claim 1, wherein the method comprises:
 - i. for a first time interval of a frame, setting the initial transmission power level; and
 - ii. for each subsequent time interval of the frame:
measuring the received signal to noise ratio over subsequent time intervals;
determining the cumulative SNR value over the received time interval of the frame;
determining the number of time intervals remaining in the frame; and,
adjusting the transmission power level in response to signalling from the receiver in respect of a further subsequent time interval based upon said cumulative SNR value and the number of time intervals remaining in the frame such that the required average signal to noise ratio is substantially achieved.
3. A method according to Claim 2, wherein the transmission power level for each subsequent slot is set by:
calculating a predicted signal to noise ratio γ_p using the sum of the measured power levels, the predetermined average S/N ratio γ_{db} and the number of remaining time slots.

4. A method according to Claim 2, wherein the required signal to noise ratio γ_p is calculated based upon the assumption that a target, of the average signal to noise ratio, γ_d , across the frame, will be met if the calculated predicted signal to noise ratio γ_p is maintained throughout the remainder of the frame, thereby keeping the average signal to noise ratio γ_d substantially constant over the frame.
5. A method according to any one of Claims 1 to 4, wherein the time interval is a time slot.
6. A method according to any one of Claims 1 to 5, wherein the communications system is a spread spectrum communications system.
7. A method according to Claim 6, wherein the spread spectrum communications systems is a CDMA communications system.
8. A method according to Claim 4, wherein the power level setting step achieves a signal to noise ratio, γ_p , which is given by the formula:

$$\gamma_p = \frac{N\gamma_d - \sum_{i=0}^{j-1} \gamma_i}{N - j}$$

wherein γ_i is the S/N ratio received at the base station in the i th interval; $\sum_{i=0}^{j-1} \gamma_i$ is the sum of S/N ratios received corresponding to previous time intervals; and $N\gamma_d$ is the desired total S/N ratio sum over the frame.

9. A method according to Claim 6, wherein the duration of a frame corresponds to a burst comprising a plurality of consecutive CDMA frames.
10. A method according to Claim 6, wherein the duration of a frame corresponds to the duration of a CDMA frame.
11. A transmitter for a communication system operable to transmit in time frames having a plurality of time intervals, the transmitter comprising a power controller operable to:
- i. for a first time interval of a frame, set the initial transmission power level; and,
 - ii. for each subsequent time interval of the frame:
 - measure the received signal to noise ratio over subsequent time intervals;
 - determine the cumulative SNR value over the received time interval of the frame;
 - determine the number of time intervals remaining in the frame; and,
 - adjust the transmission power level in response to signalling from the receiver in respect of a further subsequent time interval based upon said cumulative SNR value and the number of time intervals remaining in the frame such that the required average signal to noise ratio is substantially achieved.

make the probability of uncorrectable errors in an interleaved frame a function more of the average S/N ratio over the frame rather than, for example, the worst case S/N ratio. Consequently, if the S/N ratio at the start of a frame is too high, implementation of power control reduces the S/N ratio to the required threshold by the end of the frame, but the overall average will be higher than necessary. Conversely, if the S/N ratio at the start of a frame is too low, implementation of power control increases the S/N ratio to the required threshold by the end of the frame, but the overall average will be lower than necessary.

It is therefore an object of the present invention to obviate or at least mitigate the above described disadvantages.

According to the present invention, there is provided a method of power control in a communications system capable of transmitting a frame having a plurality of time intervals from a transmitter to a receiver, wherein power control is effected on the individual time intervals based upon information passed from the receiver to the transmitter, wherein the receiver seeks to maintain an average signal to noise ratio across the frame.

In accordance with a further aspect of the invention, there is provided a method according to claim 1, wherein the method comprises: i. for a first time interval of a frame, setting the initial transmission power level; and ii. for each subsequent time interval of the frame: measuring the received signal to noise ratio over subsequent time intervals; determining the cumulative SNR value over the received time interval of the frame; determining the number of time intervals remaining in the frame; and, adjusting the transmission power level in response to signalling from the receiver in respect of a further subsequent time interval based upon said cumulative SNR value and the number of time intervals remaining in the frame such that the required average signal to noise ratio is substantially achieved.

3a

Thus, if the signal is received at a S/N ratio higher than necessary at the beginning of a frame, the method will ensure that the signal will be received at a level lower than the nominal S/N ratio by the end of the frame. Where multi-path fading occurs the use of this method will result in smaller variation in average power over the frame, leading to an improvement in system capacity.

In accordance with another aspect of the invention, there is provided a transmitter for a communication system operable to transmit in time frames having a plurality of time intervals, the transmitter comprising a power controller operable to:

- i. for a first time interval of a frame, set the initial transmission power level; and,
- ii. for each subsequent time interval of the frame: measure the received signal to noise ratio over subsequent time intervals; determine the cumulative SNR value over the received time interval of the frame; determine the number of time intervals remaining in the frame; and, adjust the transmission power level in response to signalling from the receiver in respect of a further subsequent time interval based upon said cumulative SNR value and the number of time intervals remaining in the frame such that the required average signal to noise ratio is substantially achieved.

PCT

INTERNATIONAL SEARCH REPORT

(PCT Article 18 and Rules 43 and 44)

Applicant's or agent's file reference 98P4851/F21518	FOR FURTHER ACTION see Notification of Transmittal of International Search Report (Form PCT/ISA/220) as well as, where applicable, item 5 below.	
International application No. PCT/GB 99/ 03496	International filing date (day/month/year) 27/10/1999	(Earliest) Priority Date (day/month/year) 27/10/1998
Applicant ROKE MANOR RESEARCH LIMITED et al.		

This International Search Report has been prepared by this International Searching Authority and is transmitted to the applicant according to Article 18. A copy is being transmitted to the International Bureau.

This International Search Report consists of a total of 3 sheets.

☒ It is also accompanied by a copy of each prior art document cited in this report.

1. Basis of the report

a. With regard to the **language**, the international search was carried out on the basis of the international application in the language in which it was filed, unless otherwise indicated under this item.

☐ the international search was carried out on the basis of a translation of the international application furnished to this Authority (Rule 23.1(b)).

b. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international search was carried out on the basis of the sequence listing :

☐ contained in the international application in written form.

☐ filed together with the international application in computer readable form.

☐ furnished subsequently to this Authority in written form.

☐ furnished subsequently to this Authority in computer readable form.

☐ the statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.

☐ the statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished

2. ☐ **Certain claims were found unsearchable** (See Box I).

3. ☐ **Unity of invention is lacking** (see Box II).

4. With regard to the **title**,

☒ the text is approved as submitted by the applicant.

☐ the text has been established by this Authority to read as follows:

5. With regard to the **abstract**,

☒ the text is approved as submitted by the applicant.

☐ the text has been established, according to Rule 38.2(b), by this Authority as it appears in Box III. The applicant may, within one month from the date of mailing of this international search report, submit comments to this Authority.

6. The figure of the **drawings** to be published with the abstract is Figure No.

3

☐ as suggested by the applicant.

☐ because the applicant failed to suggest a figure.

☒ because this figure better characterizes the invention.

☐ None of the figures.

INTERNATIONAL SEARCH REPORT

International Application No.

PCT/GB 99/03496

A. CLASSIFICATION OF SUBJECT MATTER

IPC 7 H04B7/005

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 H04B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 5 305 468 A (BRUCKERT EUGENE J ET AL) 19 April 1994 (1994-04-19) abstract column 3, line 29 -column 5, line 56 claims 1-3 figures 5-7	1,8
A	WO 97 17769 A (MARTIN PAUL MAXWELL ;IONICA INT LTD (GB); GOODINGS RUPERT LESLIE A) 15 May 1997 (1997-05-15) page 1, line 13 -page 4, line 19 claims 1,2 -/--	1,8



Further documents are listed in the continuation of box C.



Patent family members are listed in annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

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Date of the actual completion of the international search

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Name and mailing address of the ISA

European Patent Office, P.B. 5818 Patentlaan 2
NL - 2280 HV Rijswijk
Tel. (+31-70) 340-2040, Tx. 31 651 epo nl,
Fax: (+31-70) 340-3016

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Gkeli, M

INTERNATIONAL SEARCH REPORT

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